Chris Field
Carnegie Science

Climate science history, Climate solutions action

Robert M. White Memorial Symposium
June 14, 2016

Four turning points in the history of climate science

1979: First World Climate Conference
1988: Creation of the IPCC
1992: UNFCCC
2015: Paris Agreement

ipcc
INTERGOVERNMENTAL PANEL ON climate change

THE

LONDON, EDINBURGH, AND DUBLIN

PHILOSOPHICAL MAGAZINE

AND

JOURNAL OF SCIENCE.

[FIFTH SERIES.]

APRIL 1896.

- **Strong IR absorption by CO_2**
- **Partitioning of CO_2 between atmosphere and oceans**
- **Amplification of CO_2 effect by increased water vapor**

XXXI. *On the Influence of Carbonic Acid in the Air upon the Temperature of the Ground.* By Prof. SVANTE ARRHENIUS *.

QUARTERLY JOURNAL OF THE ROYAL METEOROLOGICAL SOCIETY

551.510.4 : 551.521.3 : 551.524.34

THE ARTIFICIAL PRODUCTION OF CARBON DIOXIDE AND ITS INFLUENCE ON TEMPERATURE

By G. S. CALLENDAR

(Steam technologist to the British Electrical and Allied Industries Research Association.)

(Communicated by Dr. G. M. B. DOBSON, F.R.S.)

[Manuscript received May 19, 1937—read February 16, 1938.]

SUMMARY

By fuel combustion man has added about 150,000 million tons of carbon dioxide to the air during the past half century. The author estimates from the best available data that approximately three quarters of this has remained in the atmosphere.

The radiation absorption coefficients of carbon dioxide and water vapour are used to show the effect of carbon dioxide on " sky radiation ". From this the increase in mean temperature, due to the

d to be at the rate

logical stations are

lly increased at an

half century.

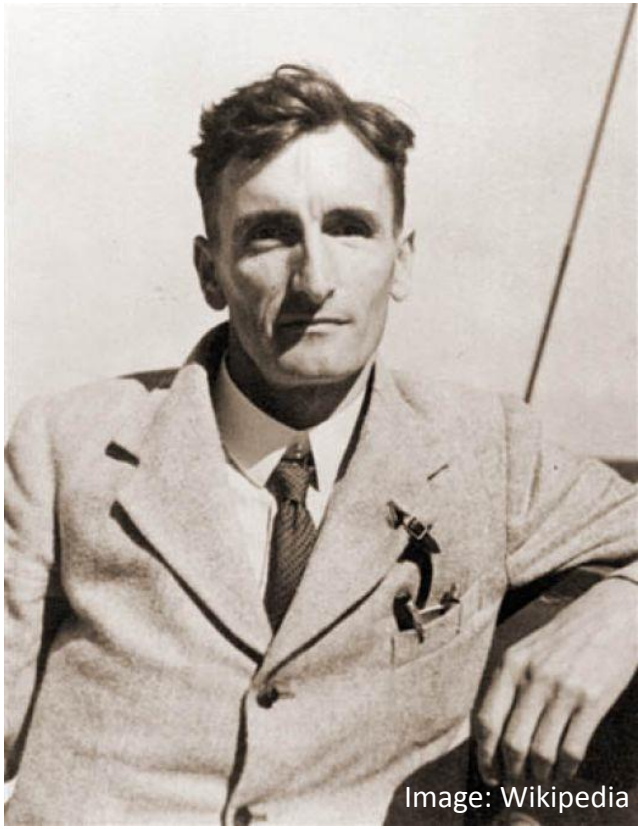
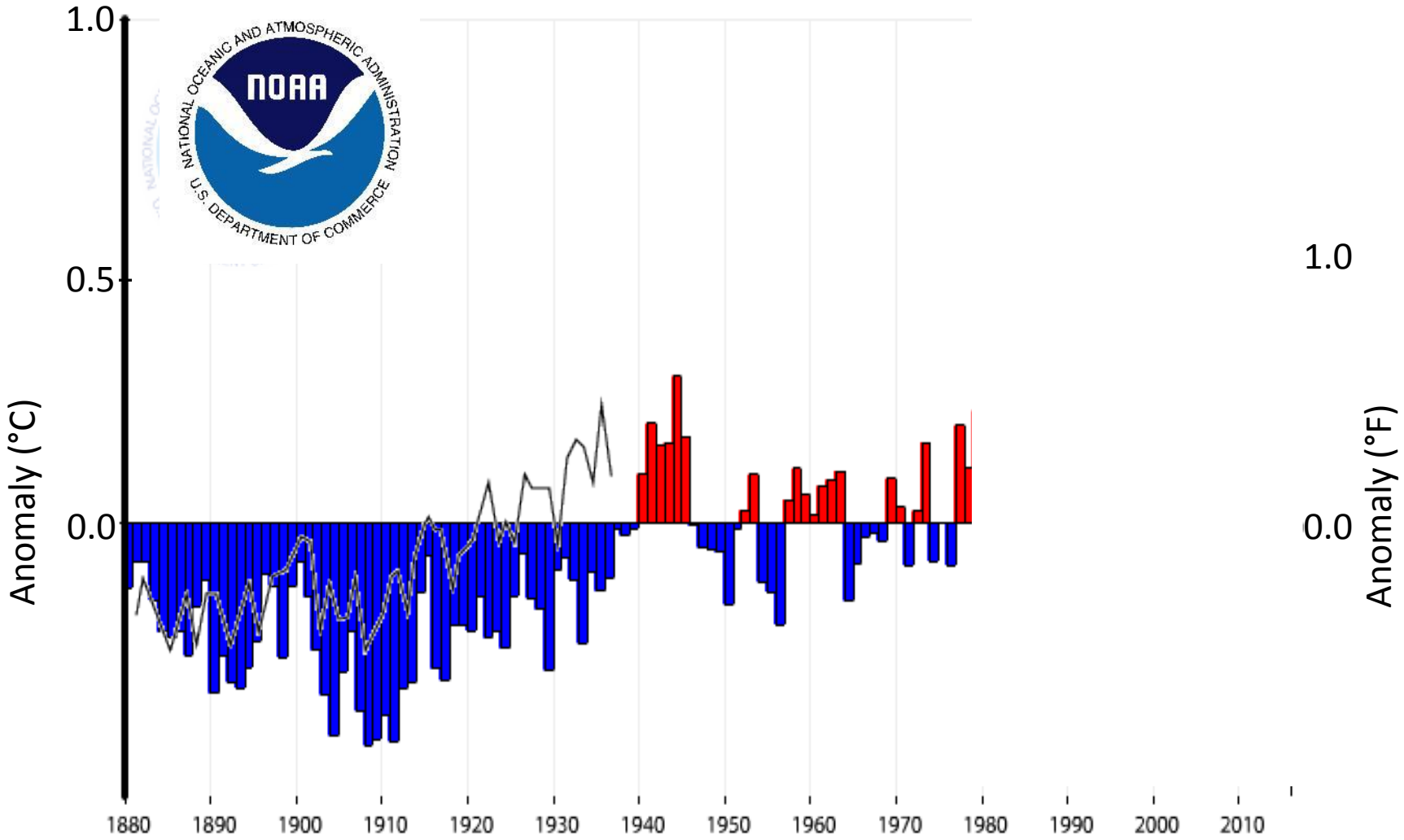
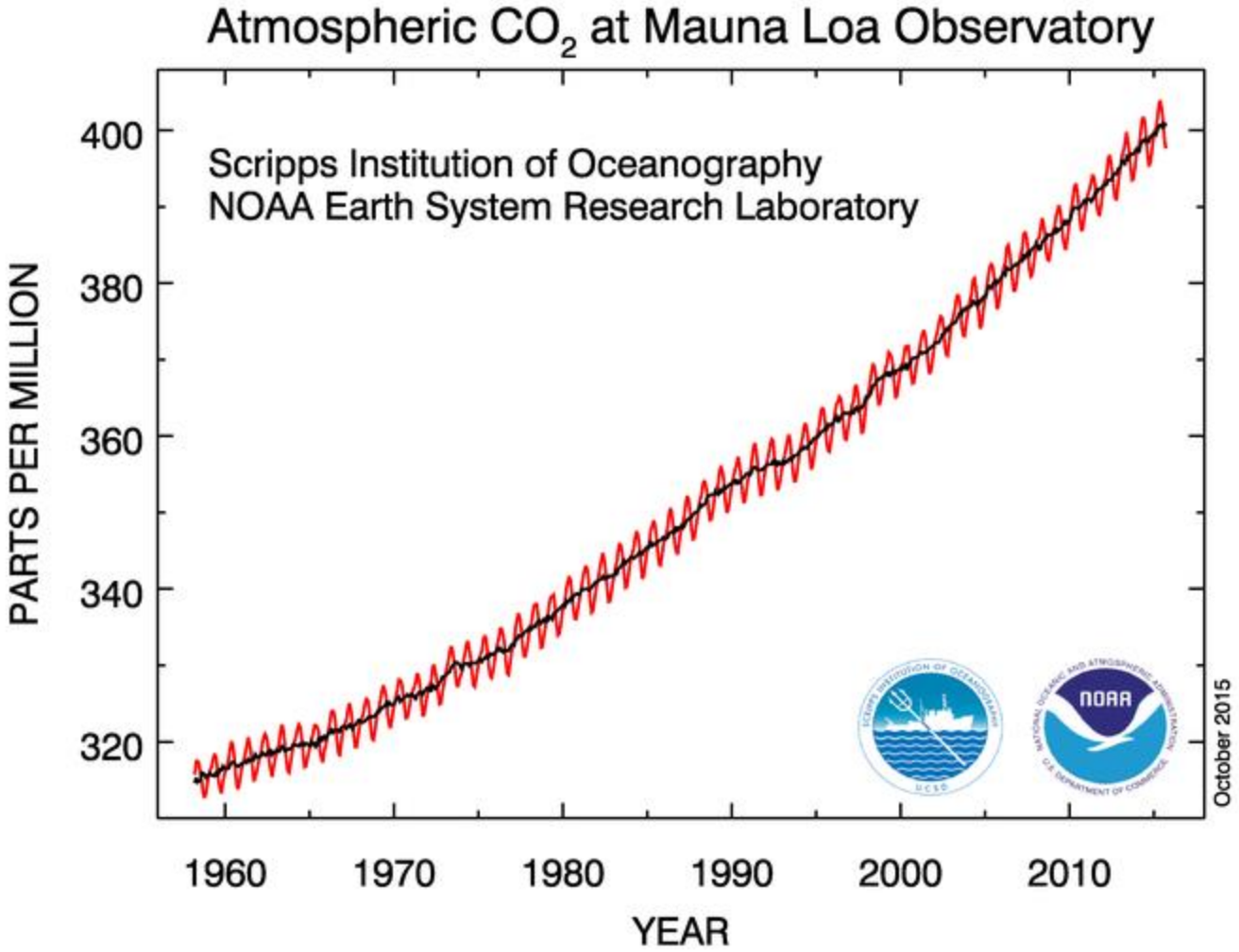


Image: Wikipedia

- Revised estimate of climate sensitivity
- Documentation of warming trend

Global land and Ocean Temperature Anomalies, Jan - Dec




Atmospheric CO_2 at Mauna Loa Observatory
Scripps Institution of Oceanography
NOAA Earth System Research Laboratory
PARTS PER MILLION
400
380
360
340
320
1960
1970
1980
1990
2000
2010
YEAR
NOAA
October 2015

RESTORING THE QUALITY OF OUR ENVIRONMENT

Report of The Environmental Pollution Panel President's Science Advisory Committee

THE WHITE HOUSE

NOVEMBER 1965

Subpanel on Atmospheric Carbon Dioxide

Roger Revelle, Wallace Broecker, Harmon Craig, Charles D. Keeling, Joseph Smagorinsky

- Melting Antarctic ice cap
- Rise of sea level
- Warming of sea water
- Increased acidity of fresh waters
- Increase in photosynthesis

JOURNAL OF THE ATMOSPHERIC SCIENCES

JANUARY 1975

The Effects of Doubling the CO_2 Concentration on the Climate of a General Circulation Model[1]

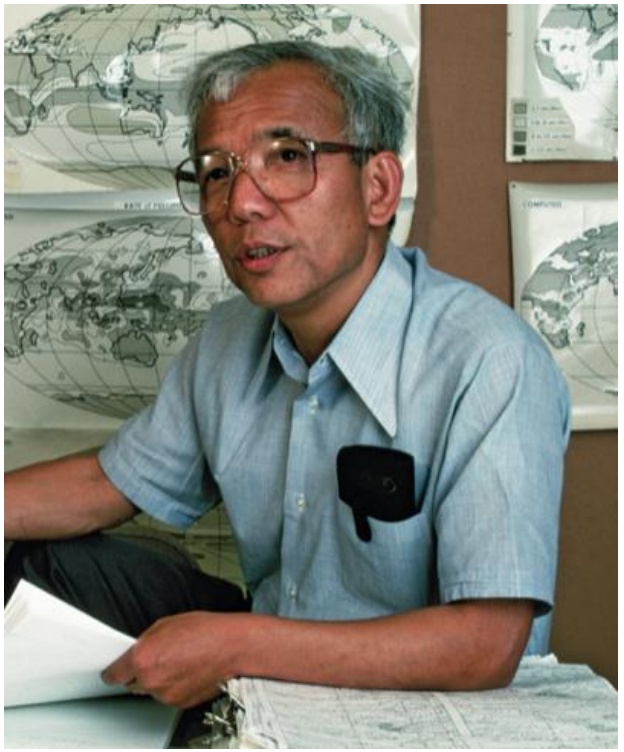
SYUKURO MANABE AND RICHARD T. WETHERALD

Geophysical Fluid Dynamics Laboratory/NOAA, Princeton University, Princeton, N.J. 08540

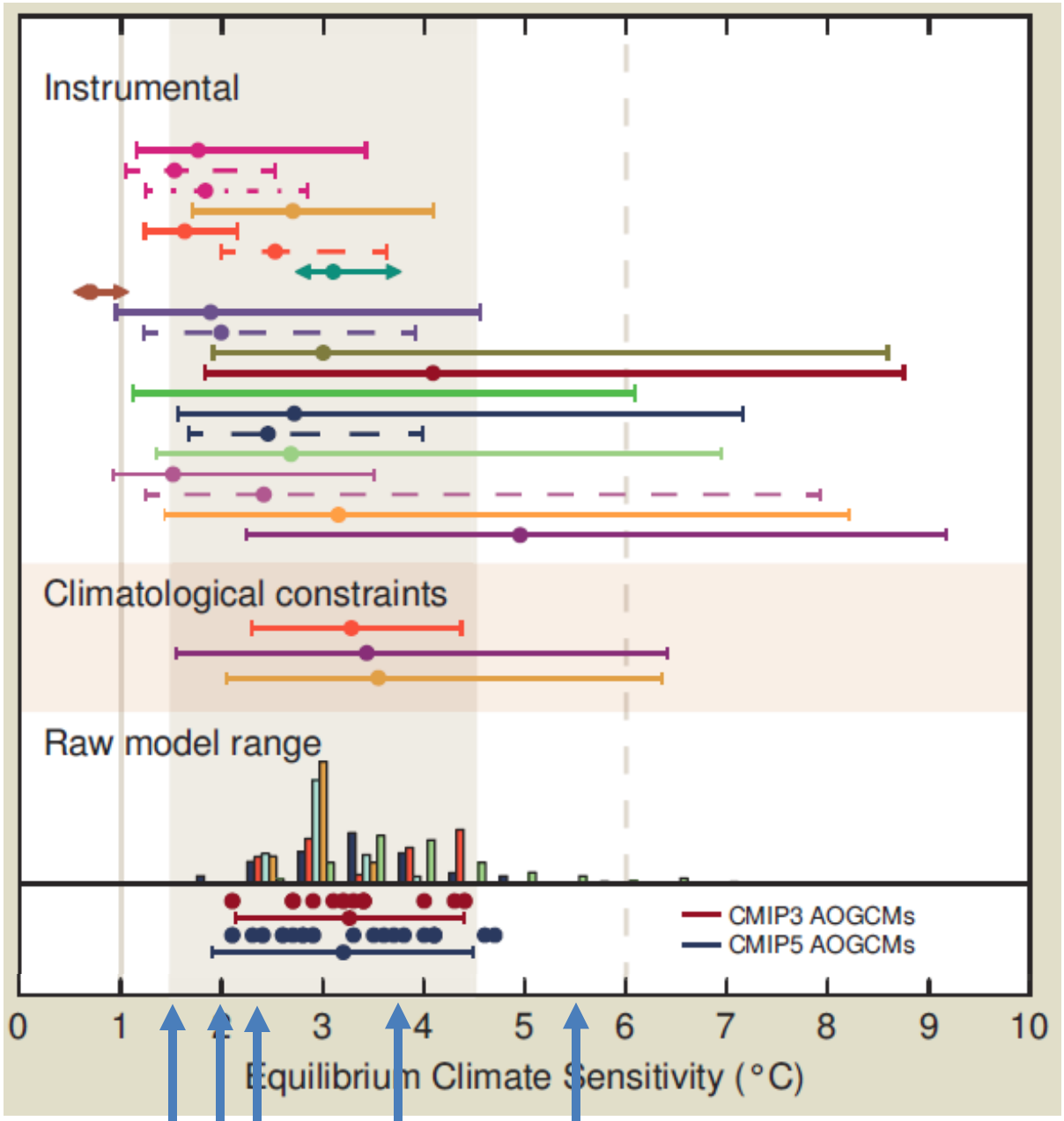
(Manuscript received 6 June 1974, in revised form 8 August 1974)

ABSTRACT

An attempt is made to estimate the temperature changes resulting from doubling the present CO_2 concentration by the use of a simplified three-dimensional general circulation model. This model contains the following simplifications: a limited computational domain, an idealized topography, no heat transport by ocean currents, and fixed cloudiness. Despite these limitations, the results from this computation yield some indication of how the increase of CO_2 concentration may affect the distribution of temperature in the atmosphere. It is shown that the CO_2 increase raises the temperature of the model troposphere, whereas it lowers that of the model stratosphere. The tropospheric warming is somewhat larger than that expected from a radiative-convective equilibrium model. In particular, the increase of surface temperature in higher latitudes is magnified due to the recession of the snow boundary and the thermal stability of the lower troposphere which limits convective heating to the lowest layer. It is also shown that the doubling of carbon dioxide significantly increases the intensity of the hydrologic cycle of the model.



- GCM-based climate sensitivity
- Zonal and elevational “fingerprints”


Instrumental
Climatological constraints
Raw model range
CMIP3 AOGCMs
CMIP5 AOGCMs
0
1
2
3
4
5
6
7
8
9
10
Equilibrium Climate Sensitivity (°C)
Möller 1963
Callendar 1938
Manabe and Wetherald 1967
Plass 1956
Arrhenius 1896

1979: First World Climate Conference

Working Groups:

- climate data
- identification of climate topics
- integrated impact studies
- climate variability and change

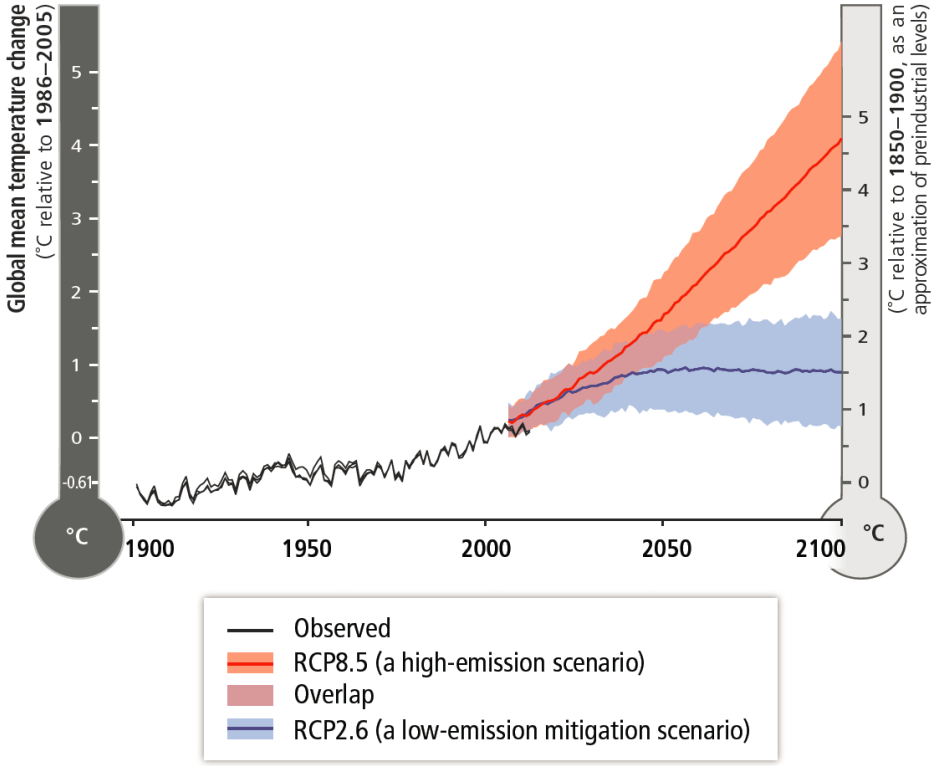
Led to:

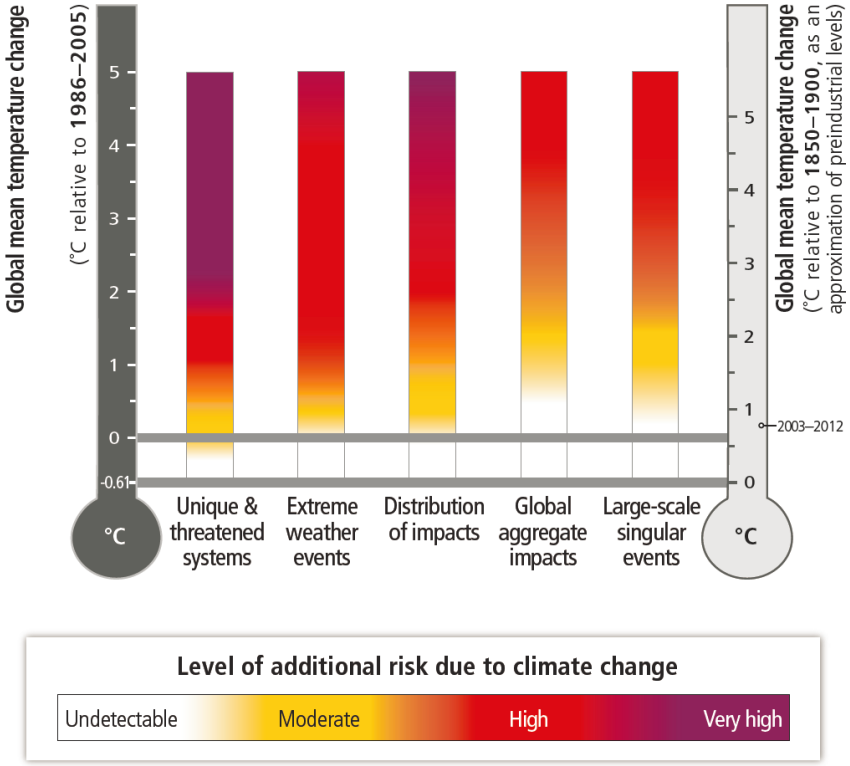
- World Climate Programme
- World Climate Research Programme
- Intergovernmental Panel on Climate Change

1988: IPCC

- Comprehensive assessments
- Multiple rounds of independently monitored reviews
- Consensus, word by word approval by governments

Understanding, managing, & reducing risks





Based on WGII Box SPM 1 Figure 1

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INTERGOVERNMENTAL PANEL ON climate change

Figure SYR SPM.10

From climate change risks to GHG emissions

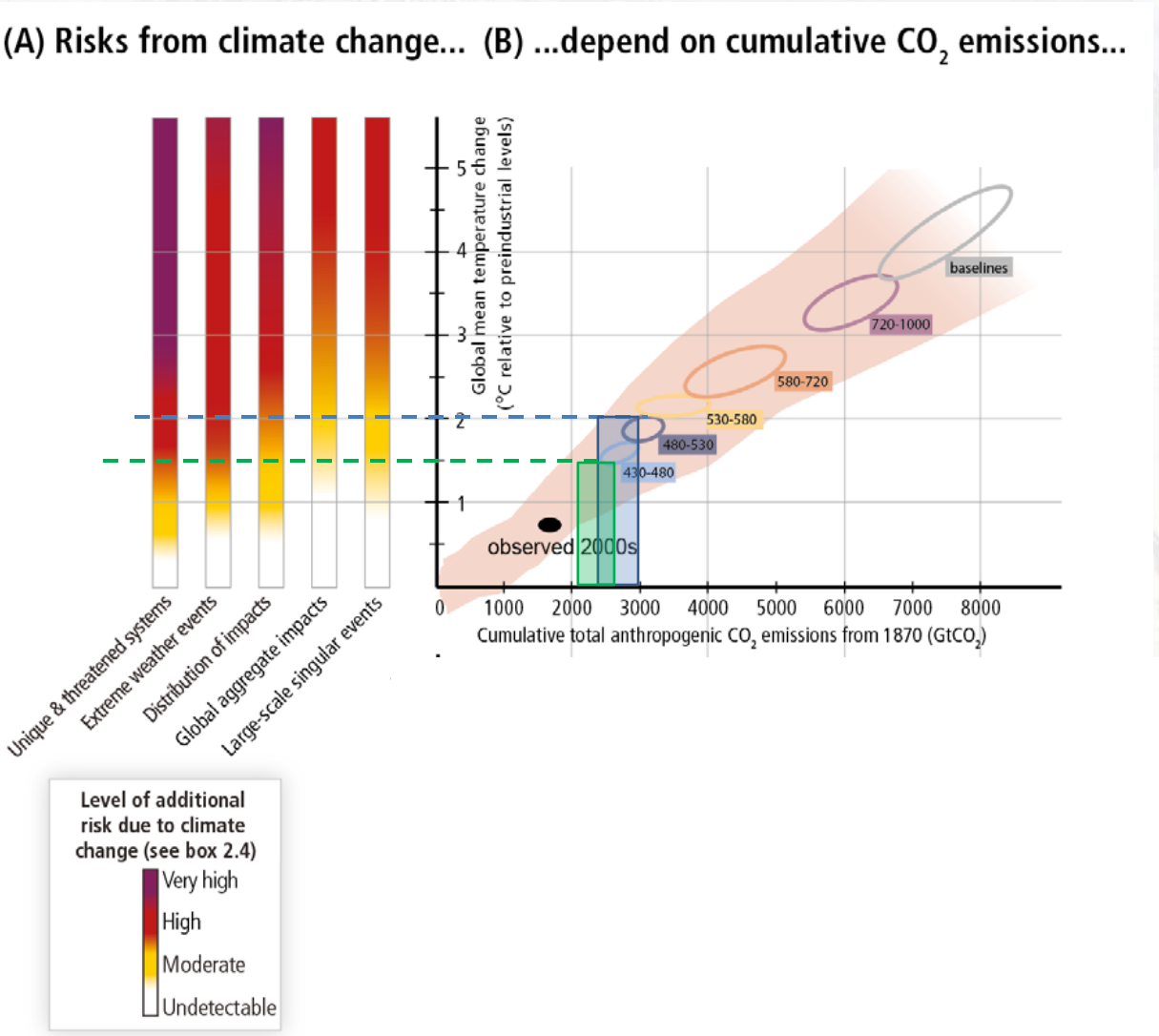

Figure SYR SPM.10

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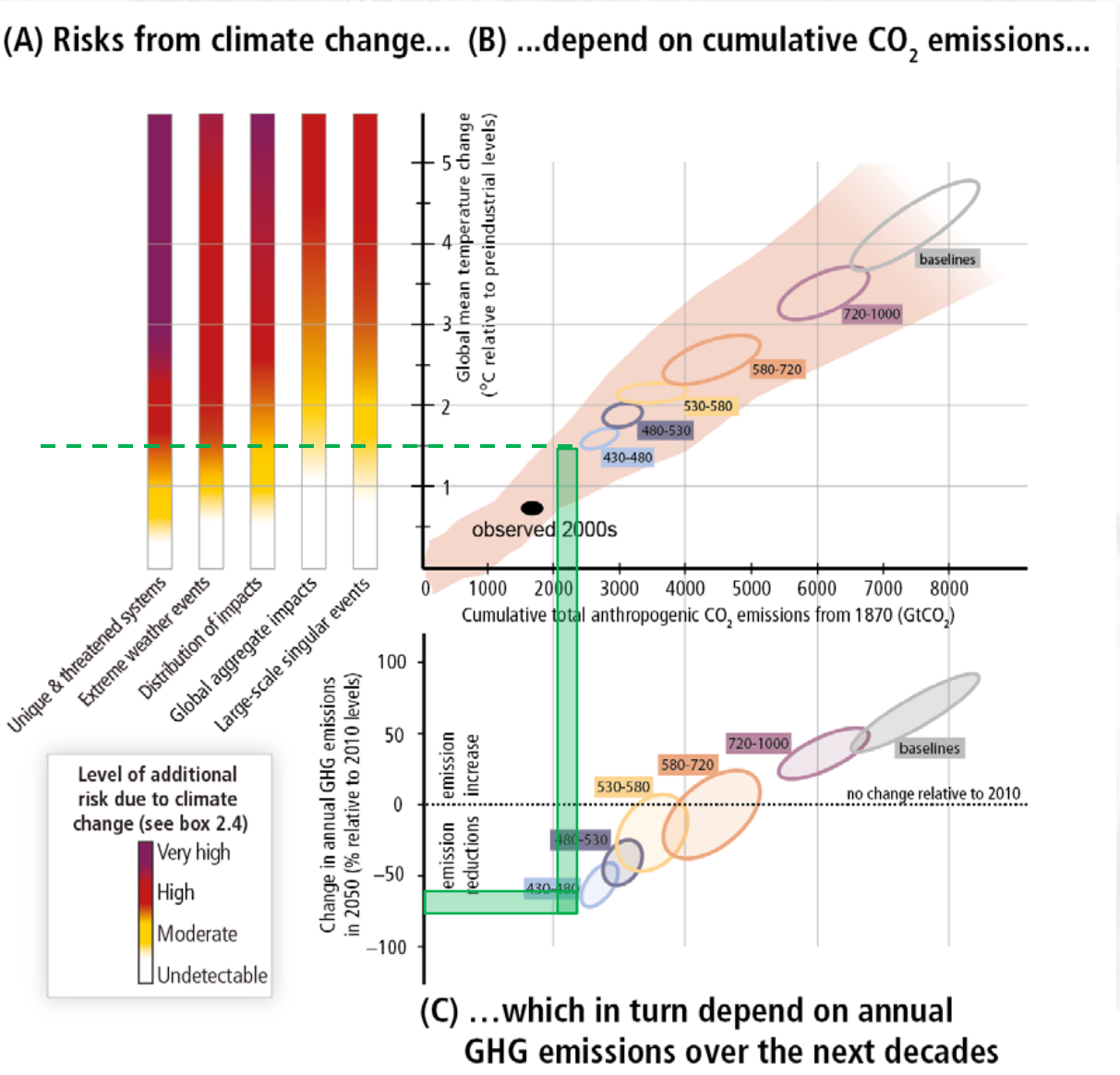

1992: UNFCCC

- Science-based
- Clear objective – Dangerous anthropogenic interference
- Common but differentiated responsibility
- Speedometer
- Mitigation and Adaptation

ipcc
INTERGOVERNMENTAL PANEL ON Climate change

Article 2 of the UNFCCC

The ultimate objective of this Convention and any related legal instruments that the Conference of the Parties may adopt is to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.

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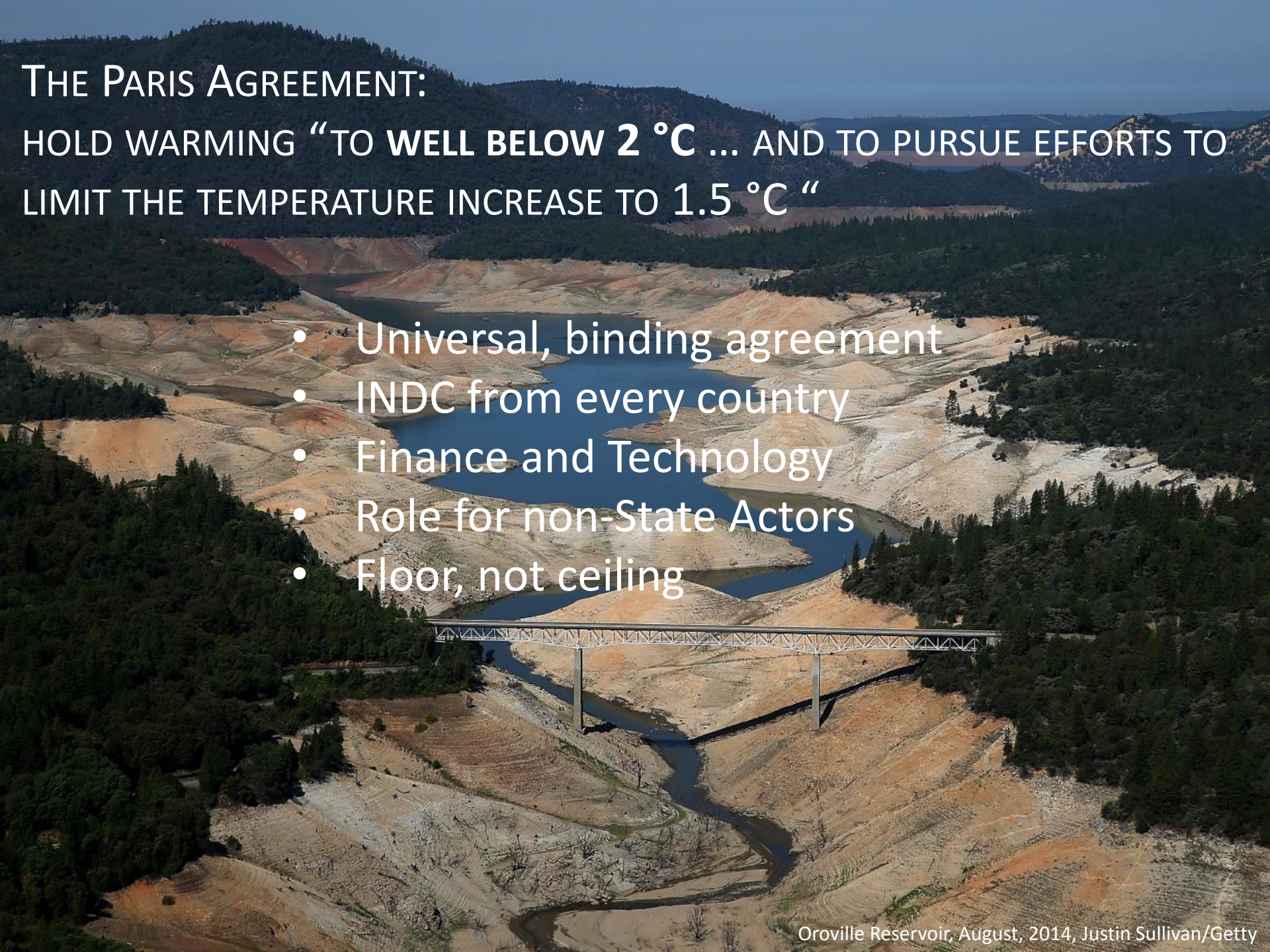
The Paris Agreement:

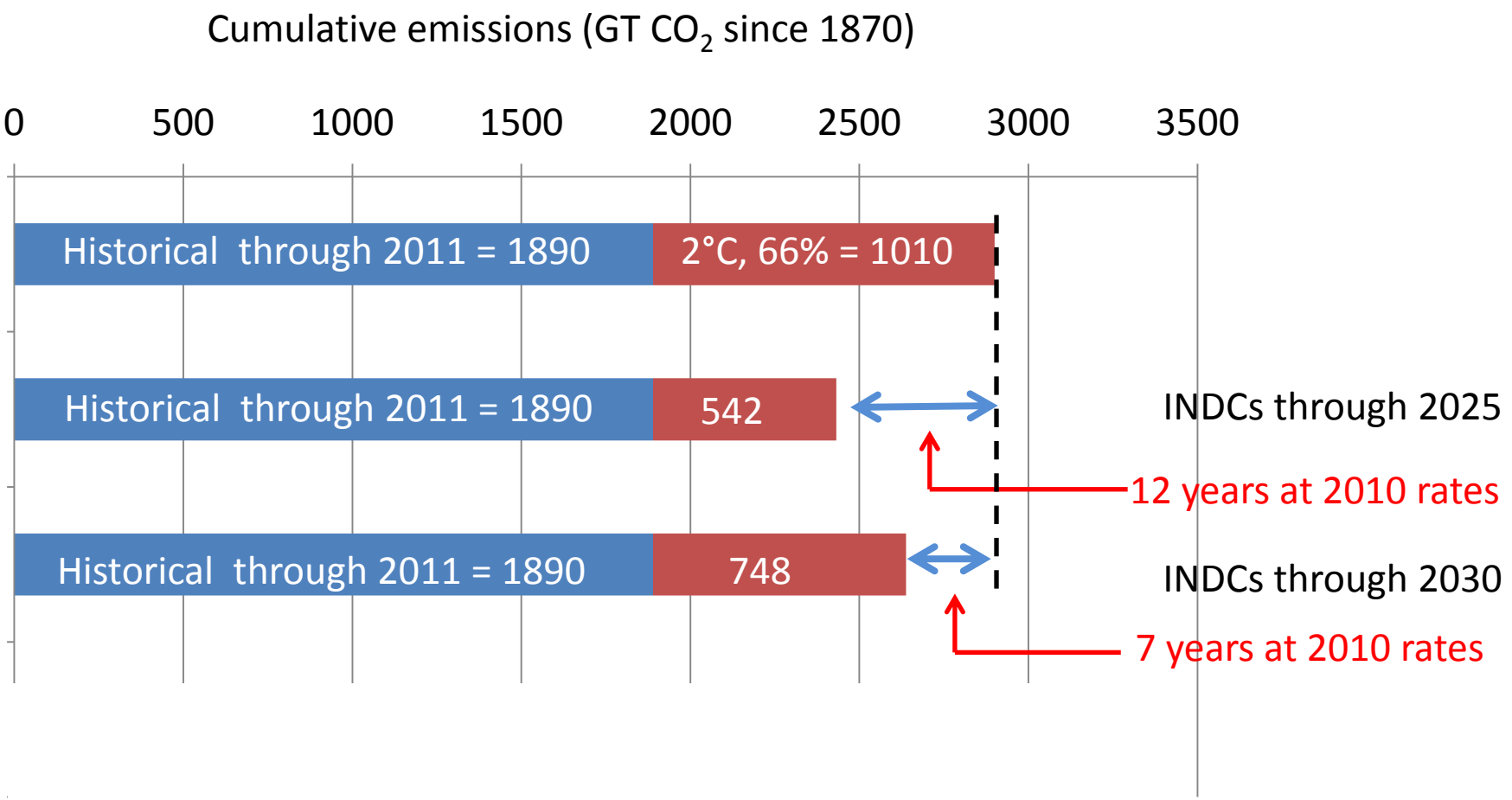
hold warming "to **well below 2 °C** … and to pursue efforts to limit the temperature increase to 1.5 °C "

- Universal, binding agreement
- INDC from every country
- Finance and Technology
- Role for non-State Actors
- Floor, not ceiling



Oroville Reservoir, August, 2014, Justin Sullivan/Getty

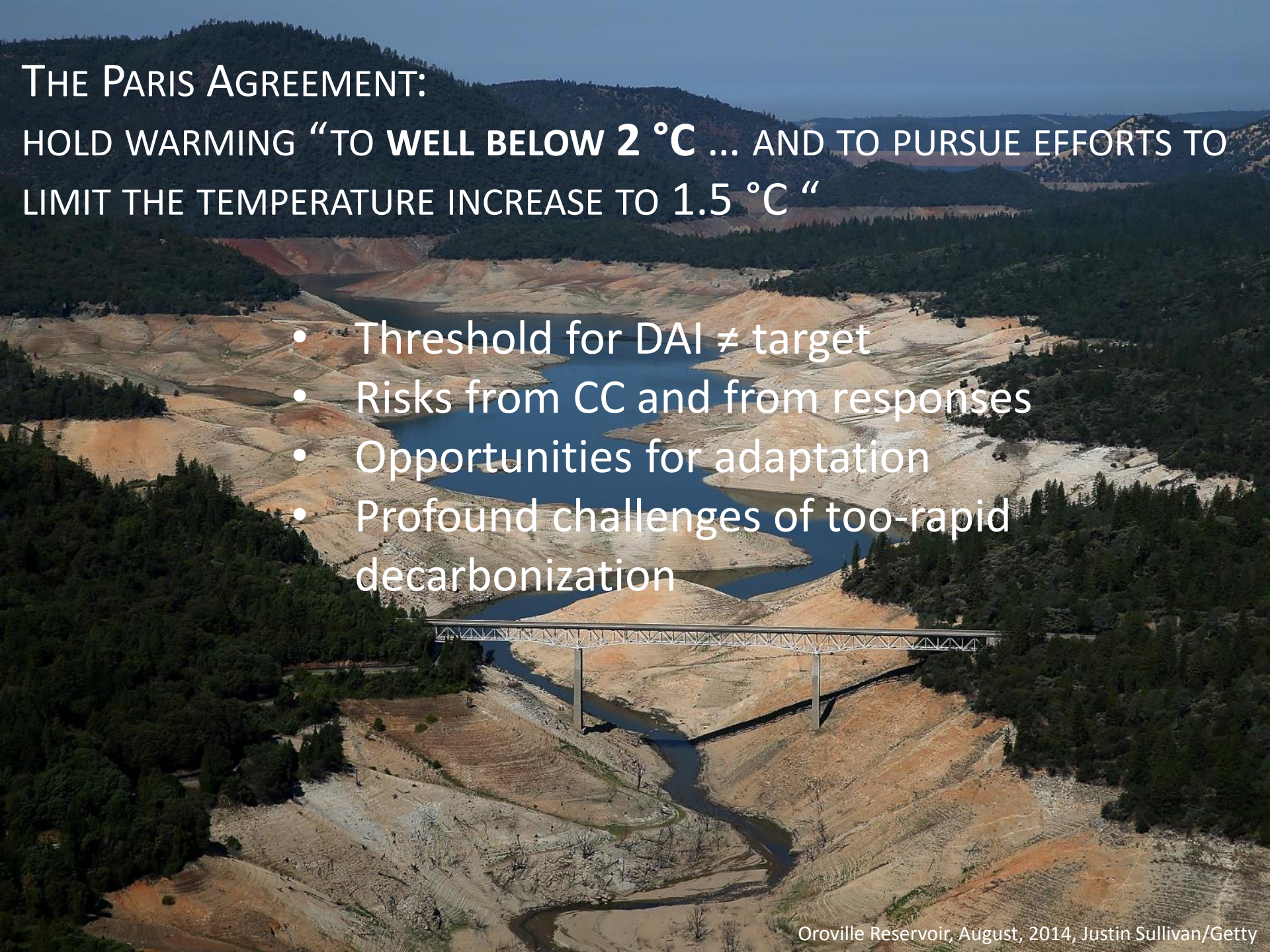
INDCs: Budget mostly used by 2030



The Paris Agreement:

hold warming "to **well below 2 °C** … and to pursue efforts to limit the temperature increase to 1.5 °C "

- Threshold for DAI ≠ target
- Risks from CC and from responses
- Opportunities for adaptation
- Profound challenges of too-rapid decarbonization



Oroville Reservoir, August, 2014, Justin Sullivan/Getty

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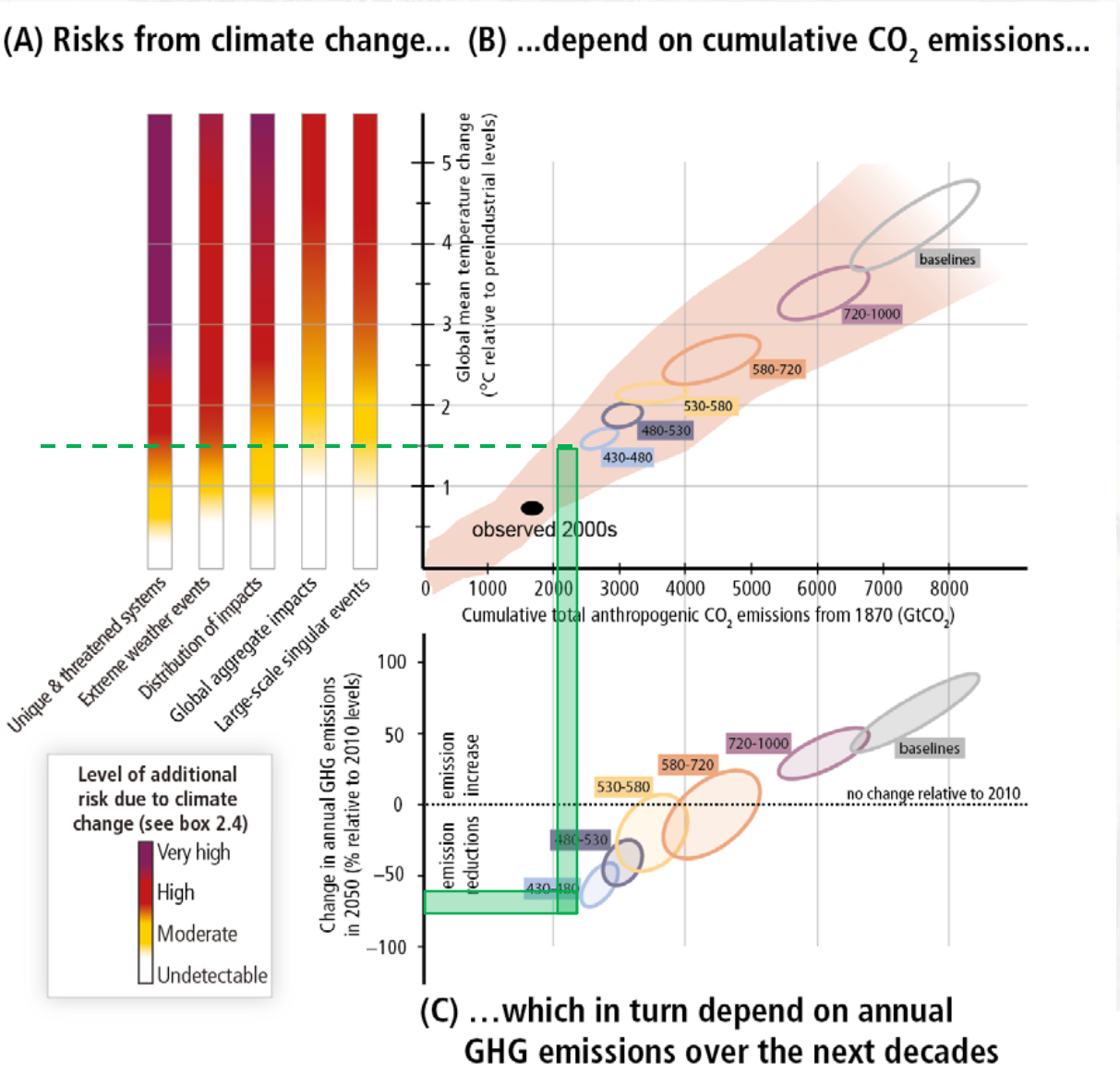

EFFECTIVE CLIMATE CHANGE RESPONSES

A MORE VIBRANT WORLD